

REMARKS

In an Office Action dated December 2, 2004, the Examiner rejects claims 1-3 and 6-16. The Examiner also withdraws claims 4, 5 and 17 from prosecution. Applicants respectfully traverse the withdrawal of claims 4, 5 and 17 from prosecution and the rejections of claims 1-3 and 6-17. In light of the amendments and following arguments applicants respectfully request that claims 1-17 and this application be allowed.

The Applicants submit the attached replacement drawings to correct the informalities cited in the office action. Thus, Applicants request that the drawings be allowed.

Applicants have amended paragraphs 52 and 84 to more properly describe the invention. Specifically, the phrase “substantially regularly spaced apart” for the word randomly to more correctly describe how islands of Germanium are formed in accordance with the Stranski-Krastanov growth method disclosed in the specification. As can be seen from Figure 6, the lateral arrangement of Ge island formed by Stranski-Krastanov growth is not strictly periodical, but nevertheless, the islands have fairly sharp distance and size distributions. Hence, the islands are not randomly distributed but are substantially regularly spaced apart.

From the above amendment, it should be apparent that claims 4, 5, and 17 are allowable under the species as having regularly spaced apart islands of Germanium. Thus, Applicants respectfully request that claims 4, 5 and 17 remain pending in this application.

The Examiner has objected to the specification because paragraph 61 recites “an additional global minimum at $k=0$ ”. However, the cited portion actually recites “an additional global minimum at $k \neq 0$ ” which is correct and proper in the context of the sentence. Therefore, Applicants respectfully request that the Examiner remove this objection.

The Examiner objects to claim 3 because the term “at which the doping density is highest” did not properly refer to a layer. Applicants have amended claim 3 to particularly point out that the highest doping level refers to the side of said active zone. Therefore, Applicants respectfully request that this objection be removed.

The Examiner objects to claim 8 because the subject matter of “a metal silicide having a silicon lattice structure” lacks adequate disclosure. However, this structure is in the common knowledge of those skilled in the art as shown in the document titled “Interface Structure and Schottky Barrier Height of Buried $\text{CoSi}_2/\text{Si}(001)$ Layers” P. Werner, et al. 74 Journal of Applied Physics 3846 (1993). This article is attached for the Examiners convenience. In light of this structure being known in the art, the disclosure is adequate. Thus, Applicants respectfully request that this objection to claim 8 be removed.

The Examiner rejects claim 1 under 35 USC §103(a) as being unpatentable over Applied Physics Letter, No. 12 September 1999, pages 1745-1747 by Liu et al. (Liu) in view of U. S. Patent Number 4,679,061 issued to Capasso et al. (Capasso). In order to maintain a rejection the Examiner has the burden of providing evidence of prima facie obviousness. See MPEP §2143. See also In Re Vaeck, 947 F.2d 488, 20 USPQ2d 1438 (Fed. Cir. 1991). In order to prove prima facie obviousness, the Examiner must provide evidence in the prior art of a motivation to combine or modify a reference, a reasonable expectation of success, and a teaching of each and every claimed element. Id. The Examiner has failed to provide a teaching of each and every claimed element and has not provided evidence of a motivation to combine the references.

Claim 1 recites “a cladding layer of the opposite conductivity type to the base layer, the cladding layer being provided on the opposite side of said active zone from said base layer, wherein the alternating Si and Ge layers of said active zone form a superlattice so that holes are located in quantized energy levels associated with a valance band and electrons are localized in a miniband associated with the conduction band and resulting from the superlattice structure.” Neither Liu nor Capasso teaches this limitation.

The structure recited in claim 1 provides light emission based on interband transitions, i.e. on the recombination of electrons and holes as recited in the cladding layer. Thereby light of comparatively high energy having a short wavelength is emitted. Specifically, wavelengths in the near infrared region, e.g. in the range from 1.3 to 1.6 μm , can be achieved. The light emission further relies on the formation of a miniband for electron, i.e. on a miniband in the region of the electron conduction band as recited in the cladding layer recited of claim 1.

In contrast, the semiconductor structure disclosed in Liu relies on a physical principle which is completely different from the physical structure recited in claim 1. In the Liu structure, light emission is caused by intraband transitions (i.e. between energy levels within one band) by transitions in either electrons or holes. In the case of electrons, the intraband transitions take place within the conduction band. In the case of the holes, the transitions take place within the valence band. In other words, light is emitted, for instance, when an electron transits from a state of higher energy to a state of lower energy in within the conduction band, the energy of the emitted light is rather small as compared with the invention, i.e. the emitted light has a rather large wavelength of about 10 μm .

For these reasons, Liu does not teach the cladding layer recited in claim 1.

Capasso also does not teach the cladding layer recited in claim 1. The semiconductor structure recited in Capasso is different from the structure of claim 1. In particular Capasso teaches the use of compound semiconductors. Further Capasso teaches the use of quantum well structures, i.e. layer structures. The Cladding layer and other layers recited in claim 1 are a heterostructure and is claimed specifically for Si and Ge which is not a compound semiconductor. Thus, Capasso does not teach the cladding layer recited in claim 1.

Since neither Liu nor Capasso teaches the cladding layer recited in claim 1, the combination of the references does not teach the cladding layer. Thus, the Examiner has failed to provide a teaching of the cladding layer. Therefore, Applicants respectfully request that the rejection of claim 1 be removed.

Furthermore, even if the combination teaches the cladding layer recited in claim 1, the Examiner has failed to provide a proper motivation to combine the references. In the office action, the Examiner merely asserts that, "it would have been obvious to one skilled in the art at the time the invention was made to incorporate the oppositely-doped base and cladding layers of Capasso into the semiconductor structure of Liu so that a functional electrooptical and/or optoelectronic device would be obtained." The Examiner has not provided evidence in the references or elsewhere in the prior art of this motivation. Thus, if the Examiner wishes to maintain this rejection, the Examiner must provide evidence in the prior art of such a motivation as required by the MPEP and case law. See MPEP 2143.01 and In re Mills, 916 F2d 680, 16 USPQ2d 1430 (Fed. Cir. 1990).

The combination also changes the principle of operation of either Liu or Capasso reference. The Liu reference teaches a structure that uses intraband transitions to emit light. Capasso teaches a structure that emits light through interband transitions. Thus, the combination of the two references would change the principle of operation of the other reference. Thus, the combination is not permitted. See MPEP §2143.01. See also In re Ratti, 270 F2d 810, 123 USPQ 349 (C.C. P. A. 1959).

For these reasons, Applicants respectfully request that the rejection of claim 1 be removed and claim 1 be allowed.

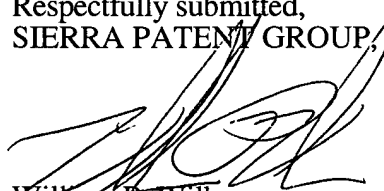
Claims 2-17 are dependent upon claim 1. Thus, claims 2-17 are allowable for at least the same reasons as claim 1. Therefore, Applicants respectfully request that the rejections of claim 2-17 be removed and claims 2-17 be allowed.

If the Examiner has any questions regarding this response or the application in general, the Examiner is invited to telephone the undersigned at 775-586-9500.

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